Plant, Cell and Environment

Cell Physiology, Whole Plant Physiology, Community Physiology, Plants and Climate Change

Board of management

Chairman	HARRY SMITH
Executive editor	E. ELLEN BILLETT
Section editors	P. G. JARVIS
	S. P. LONG
	J. A. RAVEN
	H. SMITH
	M. STITT

VOLUME 16

1993

BLACKWELL SCIENTIFIC PUBLICATIONS

Oxford · London · Edinburgh · Boston · Melbourne

Paris · Berlin · Vienna

© 1993 Blackwell Scientific Publications Ltd

Authorization to photocopy items for internal or personal use, or for the internal or personal use of specific clients is granted by Blackwell Scientific Publications Ltd for libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of $10.00 per copy is paid directly to CCC, 27 Congress Street, Salem, MA 01970, USA. This consent does not extend to other kinds of copying, such as copying for general distribution for advertising or promotional purposes, for creating new collective works or for resale. Special requests should be addressed to the Executive Editor. 0140 7791/93 $10.00.

Published by Blackwell Scientific Publications Ltd
Osney Mead, Oxford OD2 0EL
25 John Street, London WC1N 2BL
23 Ainslie Place, Edinburgh EH3 6AJ
Suite 500, 5th Floor, 238 Main Street, Cambridge, MA 02142, U.S.A
54 University Street, Carlton, Victoria 3053, Australia

Other Editorial Offices:
Arnette SA, 1 Rue de Lille, 75006 Paris, France
Blackwell Wissenschaft-Verlag GmbH, Düsseldorfer Strasse 38,
D-10707 Berlin, Germany
Blackwell MZV, Feldgasse 13, A-1238 Vienna, Austria

Typeset by RD Composition Ltd, Glasgow
Printed by Bell and Bain Ltd, Glasgow

Plant, Cell and Environment (1993) **16**

Contents

PART 1

1 *Mathematical models of the photosynthetic response* of tree stands to rising CO_2 concentrations and temperatures: commissioned review
R. E. McMurtrie & Y.-P. Wang

15 *Physiological processes limiting plant growth in saline* soils: some dogmas and hypotheses
R. Munns

25 Asymmetric patchy stomatal closure for the two surfaces of *Xanthium strumarium* L. leaves at low humidity
K. A. Mott, Z. G. Cardon & J. A. Berry

35 The differential role of mechanisms for drought resistance in a Mediterranean evergreen shrub: a simulation approach
S. Rambal

45 Estimating transpiration from 6-year-old *Eucalyptus grandis* trees: development of a canopy conductance model and comparison with independent sap flux measurements
P. J. Dye & B. W. Olbrich

55 Daily fluctuations of titratable acidity, content of organic acids (malate and citrate) and soluble sugars of varieties and wild relatives of *Ananas comosus* L. growing under natural tropical conditions
E. Medina, M. Popp, E. Olivares, H.-P. Janett & U. Lüttge

65 The functional significance of palisade tissue: penetration of directional versus diffuse light *T. C. Vogelmann & G. Martin*

73 Influence of ultraviolet-B (UV-B) radiation on photosynthetic and growth characteristics in field-grown cassava (*Manihot esculentum* Crantz)
L. H. Ziska, A. H. Teramura, J. H. Sullivan & A. McCoy

81 Feedback limitation of photosynthesis of *Phaseolus vulgaris* L. grown in elevated CO_2
F. X. Socias, H. Medrano & T. D. Sharkey

87 Relationship between leaf water spin-lattice relaxation time and water relation parameters in three wheat cultivars
S. Nagarajan, S. S. Chahal, P. N. Gambhir & P. N. Tiwari

93 Effects of atmospheric CO_2 enrichment on early growth of *Vivia faba*, a plant with large cotyledons
K. M. Radoglou & P. G. Jarvis

99 Intensity of hydrostimulation for the induction of root hydrotropism and its sensing by the root cap
H. Takahashi & T. K. Scott

105 Signal transmission during gravitropic curvature of primary roots of *Zea mays*
R. Moore & E. Maimon

109 Book reviews

PART 2

111 *Wall-to-membrane linkers in onion epidermis: some* hypotheses: opinion
R. F. Pont-Lezica, J. G. McNally & B. G. Pickard

125 Nodule growth and activity may be regulated by a feedback mechanism involving phloem nitrogen: opinion
R. Parsons, A. Stanforth, J. A. Raven & J. I. Sprent

137 Plant growth modelling *without integrating* mechanisms: model
J. M. Cheeseman

149 Acclimation processes in the light harvesting complex of the red alga *Porphyridium purpureum* (Bory) Drew et Ross, accoring to irradiance and nutrient availability
P. Algarra & W. Rüdiger

161 Field investigations of ammonia exchange between barley plants and the atmosphere. I. Concentration profiles and flux densities of ammonia
J. K. Schjoerring, A. Kyllingsbaek, J. V. Mortensen & S. Byskov-Nielsen

169 *Field investigations of ammonia exchange between* barley plants and the atmosphere. II. Nitrogen reallocation, free ammonium content and activities of ammonium assimilating enzymes in different leaves
J. K. Schjoerring, A. Kyllingsbaek, J. V. Mortensen & S. Byskov-Nielsen

179 Fructan contents and dry matter deposition in different tissues of the wheat grain during development
H. Schnyder, C. Gillenberg & J. Hinz

189 Effects of doubled atmospheric carbon dioxide concentration on the responses of assimilation and conductance to humidity
J. A. Bunce

199 Root growth as a function of ammonium and nitrate in the root zone
A. J. Bloom, L. E. Jackson & D. R. Smart

207 Modulation of photosynthesis and respiration in guard and mesophyll cell protoplasts by oxygen concentration
B. T. Mawson

215 The effects of external NaCl on thylakoid stacking in lettuce plants
D. R. Carter & J. M. Cheeseman

223 Photoinhibition of radish (*Raphanus sativus* L.) seed germination: control of growth potential by cell-wall yielding in the embryo
P. Schopfer & C. Plachy

229 Light induction of alternative pathway capacity in leaf slices of Belgium endive
O. K. Atkin, W. R. Cummins & D. E. Collier

PART 3

237 Nitrogen relations of the sorghum-*Striga hermonthica*

host-parasite association: growth and photosynthesis
I. Cechin & M. C. Press

249 Photoinhibition of isolated mesophyll cells from cold-hardened and non-hardened winter rye
L. Lapointe & N. P. A. Huner

259 Relationships between the kinetics of NH_4^+ and NO_3^- absorption and growth in the cultivated tomato (*Lycopersicon esculentum* Mill. cv T-5)
D. R. Smart & A. J. Bloom

269 Extraction of water from *Eucalyptus* trees for analysis of deuterium and oxygen-18: laboratory and field techniques
P. J. Thorburn, G. R. Walker & J.-P. Brunel

279 Limitation of transpiration by hydraulic conductance and xylem cavitation in *Betula occidentalis*
J. S. Sperry & W. T. Pockman

289 The effects of temperature and pH on the apparent Michaelis constant of glutathione reductase from maize (*Zea mays L.*)
L. B. Turner & C. J. Pollock

297 The effect of ammonium ions on membrane potential and anion flux in roots of barley and tomato
S. M. Ayling

305 *Prosopis chilensis* is a plant highly tolerant to heat shock
C. Medina & L. Cardemil

311 The effects of enhanced ozone and enhanced carbon dioxide concentrations on biomass, pigments and antioxidative enzymes in spruce needles (*Picea abies* L.)
A. Polle, T. Pfirrmann, S. Chakrabarti & H. Rennenberg

317 Effects of water velocity on photosynthesis and dark respiration in submerged stream macrophytes
T. V. Madsen, J. O. Enevoldsen & T. B. Jørgensen

323 Sodium relations in Chenopodiaceae: a comparative approach
C. Reimann & S.-W. Breckle

329 Purification of β1,4 glucanase from ethylene-treated leaflet abscission zones of *Sambucus nigra*
S. T. J. Webb, J. E. Taylor, S. A. Coupe, L. Ferrarese & A. J. Roberts

335 NMR imaging of root water distribution in intact *Vicia faba* L. plants in elevated atmospheric CO_2: short communication
P. A. Bottomley, H. H. Rogers & S. A. Prior

339 Book Reviews

PART 4

341 Integration of hydraulic and chemical signalling in the control of stomatal conductance and water status of droughted plants: opinion
F. Tardieu & W. J. Davies

351 Characteristics of inorganic nitrogen assimilation of plants in fire-prone Mediterranean-type vegetation
G. R. Stewart, J. S. Pate & M. Unkovich

365 ^{15}N natural abundance of plant and soil components of a *Banksia* woodland ecosystem in relation to nitrate utilization, life form, mycorrhizal status and N_2-fixing abilities of component species
J. S. Pate, G. R. Stewart & M. Unkovich

475 Effects of the ecto- and VA-mycorrhizal fungi *Hydnagium carneum* and *Glomus clarum* on the $\delta^{15}N$ and $\delta^{13}C$ values of *Eucalyptus globulus* and *Ricinus communis*
L. L. Handley, M. J. Daft, J. Wilson, C. M. Scrimgeour, K. Ingleby & M. A. Sattar

383 Ear photosynthesis, carbon isotope discrimination and the contribution of repiratory CO_2 to differences in grain mass in durum wheat
J. L. Araus, H. R. Brown, A. Febrero, J. Bort & M. Serret

393 Plastid-localized 3-deoxy-*D-arabino*-heptulosonate 7-phosphate synthase (DS-Mn): the early-pathway target of sequential feedback inhibition in higher plants
R. L. Doong, R. J. Ganson & R. A. Jensen

403 Investigation of phospho*enol*pyruvate carboxylase (PEPCase) in *Mesembryanthemum crystallinum* L. in C_3 and CAM photosynthetic states
S. P. Slocombe, G. C. Whitelam & W. Cockburn

413 Stomatal control by both [ABA] in the xylem sap and leaf water status: a test of a model for droughted or ABA-fed field-grown maize
F. Tardieu, J. Zhang & D. J. G. Gowing

421 Degradation of proteins from thylakoid membranes in senescing wheat leaves at high temperature
D. L. Ferguson, K. Al-Khatib, J. A. Guikema & G. M. Paulsen

429 Stomatal and environmental control of transpiration in a lowland tropical forest tree
F. C. Meinzer, G. Goldstein, N. M. Holbrook, P. Jackson & J. Cavelier

437 Stress perception and response in a facultative halophyte: the regulation of salinity-induced genes in *Mesembryanthemum crystallinum*
D. M. Vernon, J. A. Ostrem & H. J. Bohnert

445 Influence of electrolytes on growth, phototropism, nutation and surface potential in etiolated cucumber seedlings
E. P. Spalding & D. J. Cosgrove

453 Xylem-transported abscisic acid: the relative importance of its mass and its concentration in the control of stomatal aperture
D. J. G. Gowing, H. G. Jones & W. J. Davies

461 Rapid photosynthetic adaptation to heat stress triggered in potato leaves by moderately elevated temperatures
M. Havaux

PART 5

469 Changing sensitivity to light and nitrate but not to gibberellins regulates seasonal dormancy patterns in *Sisymbrium officinale* seeds
M. P. M. Derkx & C. M. Karssen

481 Role of abscisic acid in chilling tolerance of rice (*Oryza sativa* L.) seedlings. I. Endogenous abscisic acid levels
T.-M. Lee, H. S. Lur & C. Chu

491 Carbonic anhydrase in *Ranunculus penicillatus* spp. *pseudofluitans*: activity, location and implications for carbon assimilation
J. R. Newman & J. A. Raven

501 Interpretation of the electrical potential on the surface of plant roots
G. Due

511 Different vulnerabilities of *Quercus ilex* L. to freeze- and summer drought-induced xylem embolism: an ecological interpretation
M. A. Lo Gullo & S. Salleo

521 Effects of increased CO_2 concentration and temperature on growth and yield of winter wheat at two levels of nitrogen application
R. A. C. Mitchell, V. J. Mitchell, S. P. Driscoll, J. Franklin & D. W. Lawlor

531 Starch-degrading enzymes during the induction of CAM in *Mesembryanthemum crystallinum*
M. J. Paul, K. Loos, M. Stitt & P. Ziegler

539 Growth and maintenance components of leaf respiration of cotton grown in elevated carbon dioxide partial pressure
R. B. Thomas, C. D. Reid, R. Ybema & B. R. Strain

547 Effects of salinity and turgor on calcium influx in *Chara*
R. J. Reid, M. Tester & F. A. Smith

555 Modulation of leaf elongation, tiller appearance and tiller senescence in spring barley by far-red light
R. H. Skinner & S. R. Simmons

563 Isoprene emission by plants is affected by transmissible wound signals
F. Loreto & T. D. Sharkey

571 The effect of flutter on the temperature of poplar leaves and its implications for carbon gain
J. S. Roden & R. W. Pearcy

579 Evidence for direct utilization of a siderophore, ferrioxamine B, in axenically grown cucumber
Y. Wang, H. N. Brown, D. W. Crowley & P. J. Szaniszlo

587 Rapid appearance of ^{13} in biogenic isoprene when $^{13}CO_2$ is fed to intact leaves
C. F. Delwiche & T. D. Sharkey

593 Heat balance sap flow guage for small diameter stems: technical report
R. S. Senock & J. M. Ham

603 Facility for studying the effects of evaluated carbon dioxide concentration and increased temperature on crops: technical report
D. W. Lawlor, R. A. C. Mitchell, J. Franklin, V. J. Mitchell, S. P. Driscoll & E. Delgado

PART 6

609 Effects of nitrogen supply and high temperature on the growth and physiology of the chickpea
S. Laurie & G. R. Stewart

623 Photosynthetic gas exchange and the stable isotope composition of leaf water: comparison of a xylem-tapping mistletoe and its host
L. B. Flanagan, J. D. Marshall & J. R. Ehleringer

633 The coupling between extra- and intracellular electric potentials in *Bidens pilosa* L.
J. M. Frachisse-Stoilsković & J. L. Julien

643 Effects of ozone on the photosynthetic apparatus and leaf proteins during leaf development in wheat
G.-Y. Nie, M. Tomasevic & N. R. Baker

653 ATP-dependent carbon transport in perfused *Chara* cells
T. Mimura, R. Müller, W. M. Kaiser, T. Shimmen & K.-J. Dietz

663 Influence of flooding with diluted sea water on morphological and physiological characteristics in hexaploid triticale
M. A. Karim, E. Nawata & S. Shigenaga

673 The dissipation of excess excitation energy in British plant species
G. N. Johnson, A. J. Young, J. D. Scholes & P. Horton

681 Relationships between carotenoid composition and growth habit in British plant species
G. N. Johnson, A. J. Young, J. D. Scholes & P. Horton

687 The effects of host carbon dioxide, nitrogen and water supply on the infection of wheat by powdery mildew and aphids
G. B. Thompson, J. K. M. Brown & F. I. Woodward

695 Effects of flooding on carbohydrate and ABA levels in roots and shoots of alfalfa
Y. Castonguay, P. Nadeau & R. R. Simard

703 Impaired phytochrome-mediated shade-avoidance responses in the *aurea* mutant of tomato
J. J. Casal & R. E. Kendrick

711 Photosynthetic acclimation to low temperature by western red cedar seedlings
H. G. Weger, S. N. Silim & R. D. Guy

719 Spectral quality during pod development modulates soybean seed fatty acid desaturation
S. J. Britz & J. F. Cavins

727 The spatial distribution of chloroplast water in *Acer plantanoides* sun and shade leaves
D. C. McCain, J. Croxdale & J. L. Markley

735 Penetration of UV-B radiation in foliage: evidence that the epidermis behaves as a non-uniform filter

T. A. Day, G. Martin & T. C. Coleman

743 Determination of foliar uptake of chemicals: influence of leaf surface microflora
L. Schreiber & J. Schönherr

749 Gravity sensing in oat coleoptiles: scatter in growth orientation under different *g*-conditions
A. Johnsson, D. K. Chapman, A. Brown, C. Johnson-Glebe, C. Karlsson & D. G. Heathcote

755 Water relations of cotton flower petals and fruit
N. L. Trolinder, B. L. McMichael & D. R. Upchurch

761 Cold-induced purpling of *Pinus contorta* seedlings depends on previous daylength treatment: short communication
E. L. Camm, J. McCallum, E. Leaf & M. R. Koupai-Abyazani

PART 7

765 Plants as competing populations of redundant organs: opinion
T. Sachs, A. Novoplansky & D. Cohen

771 The boundary layer and the apparent responses of stomatal conductance to wind speed and to the mole fractions of CO_2 and water vapour in the air
P. J. Aphalo & P. G. Jarvis

785 *In vivo* photosynthetic electron transport does not limit photosynthetic capacity in phosphate-deficient sunflower and maize leaves
J. Jacob & D. W. Lawlor

797 Foliar gas exchange responses of two deciduous hardwoods during 3 years of growth in elevated CO_2: no loss of photosynthetic enhancement
C. A. Gunderson, R. J. Norby & S. D. Wullschleger

809 Chloroplast thylakoid protein changes induced by low growth temperature in maize revealed by immunocytology
E. J. Robertson, N. R. Baker & R. M. Leech

819 Changes in ethylene and polyamines in relation to mRNA levels of the large and small subunits of ribulose bisphosphate carboxylase/oxygenase in ozone-stressed potato folige
G. Nagi Raddy, R. N. Arteca, Y.-R. Dai, H. E. Flores, F. B. Negm & E. J. Pell

827 Growth responses of individual roots of *Opuntia ficus-indica* to salinity
M. Gersani, E. A. Graham & P. S. Nobel

835 Interactive effects of high temperature and elevated carbon dioxide concentration on cowpea [*Vigna unguiculata* (L.) Walp.]
F. E. Ahmed, A. E. Hall & M. A. Madore

843 Nitrogen and phosphorous dynamics of a tallgrass prarie ecosystem exposed to elevated carbon dioxide
C. E. Owensby, P. I. Coyne & L. M. Auen

851 Abaxial and adaxial stomata from Pima cotton (*Gossypium barbadense* L.) differ in their pigment content and sensitivity to light quality
Z. Lu, M. A. Quiñones & E. Zeiger

859 Long-term effects of elevated CO_2 and nutrients on photosynthesis and rubisco in loblolly pine seedlings
D. T. Tissue, R. B. Thomas & B. R. Strain

867 Stored xylem sap from wheat and barley in a drying soil contains a transpiration inhibitor with a large molecular size
R. Munns, J. B. Passioura, B. V. Milborrow, R. A. James & T. J. Close

873 Natural CO_2 springs in Italy: a resource for examining long-term response of vegetation to rising atmospheric CO_2 concentrations
F. Miglietta, A. Raschi, I. Bettarini, R. Resti & F. Selvi

879 Drought-induced leaf shedding in walnut: evidence for vulnerability segmentation
M. T. Tyree, H. Cochard, P. Cruiziat, B. Sinclair & T. Ameglio

883 Stabilizing microtublules with taxol increases microfilament stability during freezing of rye root tips: short communication
B. Chu, G. P. Kerr & J. V. Carter

PART 8

891 Gamete orientation and induction of gametogenesis by pheromones in algae and plants: commissioned review
I. Maier

909 Growth and onto-morphogenesis of soybean (*Glycine max* Merril) in a open, naturally CO_2-enriched environment
F. Miglietta, A. Raschi, R. Resti & M. Badiani

919 Fructose-containing carbohydrates in the tuberous root of *Gomphrena macrocephala* St.-Hil. (Amaranthaceae) at different phenological phases
C. C. J. Vieira & R. C. L. Figueiredo-Ribeiro

929 Photosynthetic acclimation to shade: probing the role of phytochromes using photomorphogenic mutants of tomato
H. Smith, G. Samson & D. C. Fork

939 Modelling carbon isotope fractionation in tree rings based on effective evapotranspiration and soil water status
J.-L. Dupouey, S. Leavitt, E. Choisnel & S. Jourdain

949 Root demography in kiwifruit (*Actinidia deliciosa*)
J. B. Reid, I. Sorensen & R. A. Petrie

959 Solute analysis and water relations of gametophyte mutants tolerant to NaCl in the fern, *Ceratopteris richardii*
D. L. Vogelien, L. G. Hickok, R. M. Augé, A. J. W. Stodola & D. Hendrix

967 Immunocytochemical localization of indole-3-acetic

acid in primary roots of *Zea mays*
L. Shi, I. Miller & R. Moore

975 The effect of a long-term water stress on the metabolism and emission of terpenes of the foliage of *Cupressus sempervirens*
A. Yani, G. Pauly, M. Faye, F. Salin & M. Gleizes

983 Blue light controls solar tracking by flowers of an alpine plant
M. L. Stanton & C. Galen

991 Functional aspects of secondary carotenoids in *Haematococcus lacustris* (Girod) Rostafinki (Volvocales). V. Influences on photomovement
C. Hagen, W. Braune, K. Vogel & D.-P. Häder

997 Applications of a thermal imaging technique in the study of the ascent of sap in woody species: technical report
T. Anfodillo, G. B. Sigalotti, M. Tomasi, P. Semenzato & R. Valentini

1003 Cellular differentiation in root caps of *Zea mays* that do not secrete mucilage: short communication
R. Moore & I. Miller

1011 Book Reviews

PART 9

1013 FORUM: Sink strength: What is it and how do we measure it?

1047 Effects of nitrogen and phosphorus deficiencies on levels of carbohydrates, repiratory enzymes and metabolites in seedlings of tobacco and their response to exogenous sucrose
M. J. Paul & M. Stitt

1059 Chemical differences between wildtype and gibberellin mutants of tomato determined by pyrolysis-mass spectrometry
G. J. Niemann, G. B. Eijkel, H. Konings, J. B. M. Purveen & J. J. Boon

1071 Enhanced ethylene production by primary roots of *Zea mays* L. in response to sub-ambient partial pressures of oxygen
R. W. Brailsford, L. A. C. Voesenek, C. W. P. M. Blom, A. R. Smith, M. A. Hall & M. B. Jackson

1081 Is wall-bound calcium redistributed during the gravireaction of stems and coleoptiles?
S. L. Bagshaw & R. E. Cleland

1091 The effects of enhanced levels of calcium on the gravireaction of sunflower hypocotyls
S. L. Bagshaw & R. E. Cleland

1099 Temperature and growth-induced water potential
J. S. Boyer

1107 Rapid and reversible modifications ofextension capacity of cell walls in elongating maize leaf tissues responding to root addition and removal of NaCl
P. M. Neumann

1115 Response of small birch plants (*Betula pendula* Roth.) to elevated CO_2 and nitrogen supply
R. Pettersson, A. J. S. McDonald & I. Stadenberg

1123 Stomatal and nonstomatal limitations of photosynthesis in 19 temperate tree species on contrasting sites during wet and dry year
M. E. Kubiske & M. D. Abrams

1131 A branch bag technique for simultaneous CO_2-enrichment and assimilation measurements on beech (*Fagus sylvatica* L.)
E. Dufrêne, J.-Y. Pontailler & B. Saugier

1139 A branch bag and CO_2 control system for long-term CO_2 enrichment of mature Sitka spruce [*Picea sitchensis* (Bong.) Carr.]: technical report
C. V. M. Barton, H. S. J. Lee & P. G. Jarvis

1149 Instructions to contributors